

Analysis of complications of laparoscopic management of abdominal diseases related to extended indications

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Abstract

Introduction: The introduction of minimally invasive procedures has changed the pattern of surgical complications. Some were only incidentally described in open surgery. Others significantly changed in character or incidence.

Aim: We present the incidence, character and dynamics of important complications of laparoscopic procedures within the entire period of application of this technique.

Material and methods: Patients operated on laparoscopically in the 2nd Department of General Surgery of the Jagiellonian University between 1992 and 2009 ($n = 8732$) were included in the study. In order to follow the dynamics of complication rates the study period was divided into 3 sub-periods: 1) 1992-1997, 2) 1998-2003, 3) 2004-2009. There were 2343 laparoscopic procedures performed in the 1st period, 3310 in the 2nd and 3079 in the 3rd.

Results: The proportion of procedures other than cholecystectomy gradually increased: 1) –22.79%, 2) –31.81%, 3) –40.05%. Overall conversion rate was 2.91%; in the 1st period it was 3.97%, in the 2nd 1.81%, and in the 3rd 3.28%. Complication-driven conversion rates were 0.60%, 0.27%, and 0.26%, respectively. Bleeding and biliary tree injuries were the most common causes. Complications requiring reoperations occurred in 0.48% of patients, and their incidence remained constant. Haemorrhage and intra-abdominal abscesses were observed most often. Use of laparoscopic technique in their management increased in consecutive periods from 20% in the 1st, 45.83% in the 2nd, to 53.57% in the 3rd time period.

Conclusions: The introduction of new advanced procedures did not increase overall complication rate. Change in their nature and more common use of laparoscopic technique in their management were noted.

Key words: complications of laparoscopy, common bile duct injuries, bleeding, intra-abdominal abscesses, re-laparoscopy.

Introduction

Any surgical intervention poses some risk of complications. It has been closely associated with surgery since its early days. Over the ages surgeons have tried to minimize the rate and severity of complications. Successive milestones in the development of surgery changed both the frequency and character of complications. Some are attributable to primary disease, risk factors and age. Hence, improvement depends on effective diagnosis and treatment affecting general

health of the patient and on progress in anaesthesiology. However, some adverse events are directly related to operative technique. The introduction and popularization of a strategy for minimization of surgical access trauma at the end of the previous century has been one of the most significant issues in contemporary surgery. Minimally invasive techniques have resulted in new complications, hardly encountered in the open surgery era. Also, events found in the past started to occur at completely different rates. In the

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beginning, laparoscopy was criticized for its higher risk of complications, including severe ones, in comparison to open surgery. The learning curve undoubtedly played a role in this issue. In many centres it lasts relatively long, as when surgeons gain some experience in simple procedures, they gradually progress to more sophisticated ones. We now believe that in the centres experienced in laparoscopic techniques the complication rate does not significantly differ from classical surgery and sometimes is even noticeably lower. Obvious advantages of minimally invasive techniques have changed this perspective and laparoscopy has become a basic surgical tool.

Aim

The aim of this study was to present morbidity, type and change of the rate of significant complications of laparoscopic surgery with respect to changing complexity of the procedures. Additionally, methods of treatment of complications were assessed.

Material and methods

Methods

Retrospective analysis of the medical records of patients operated on with laparoscopy in the 2nd Department of General Surgery, *Collegium Medicum* of Jagiellonian University in 1992-2009 was per-

formed. To analyse the dynamics of severe complications the material was divided into 3 six-year periods: 1st – 1992-1997, 2nd – 1998-2003 and 3rd – 2004-2009. Indications for surgery in different time periods were analysed in two groups: cholecystectomies, other procedures.

Occurrence of intraoperative and early postoperative complications due to specific indications was assessed in each time period. Adverse events were categorized as:

- haemorrhage,
- biliary tree injury,
- intra-abdominal abscesses,
- other.

Patients

Patients operated on with laparoscopy ($n = 8732$) were included in the study. Mean age was 51.8 ± 4.14 years. There were 5692 women (65.19%) and 3040 men (34.81%). Mean women's age was 53.7 ± 3.34 years and men's 49.3 ± 2.08 years. Of the whole group, 5912 persons (67.7%) were operated on for gallstones, and 2820 (32.3%) underwent other procedures. There were 856 patients with acute appendicitis in the latter group, 95 with perforated peptic ulcer, 269 patients with haematological disorders requiring splenectomy, 228 patients with hormonally active or mute adrenal gland tumours, 135 patients with gastroesophageal reflux disease, 930 with inguinal hernia and 307 patients with other disease (Table I).

Results

During the 1st period (1992-97) 2343 laparoscopic procedures were performed, 3310 in the 2nd (1998-2003), and 3079 in the 3rd time period (2004-2009). Women were operated on more often in each of the study periods, although the percentage decreased gradually from 67.12% to 65.23% and 64.21%, respectively. Mean age of both men and women steadily increased over time. Mean age of women was 47.6 years, 52.8 and 54.2 and of men 45.8, 48.9 and 51.3 years in the 1st, 2nd and 3rd time period, respectively (Table II).

Cholecystectomy was the most frequent procedure irrespectively of the time-frame, although its proportion decreased progressively from 1809 procedures in the 1st period (77.21%), 2257 in the 2nd (68.19%) to 1846 in the 3rd (59.95%). The rate of more advanced laparoscopic procedures grew significantly,

Table I. Types of laparoscopic procedures performed in 1992-2009 in the 2nd Department of Surgery, *Collegium Medicum* of Jagiellonian University

Type of procedure		Number of patients		Mean age [years]
		<i>n</i>	%	
Cholecystectomy		5912	67.70	46.4
Other	Appendectomy	856	9.80	38.4
	Ulcer perforation	95	1.09	41.3
	Hernia repair	930	10.65	53.2
	Fundoplication	135	1.55	44.4
	Splenectomy	269	3.08	39.4
	Adrenalectomy	228	2.61	52.1
	Other	307	3.52	56.7
Total		8732	100	51.8

from 22.79% (534 patients) in the 1st period, 31.81% (1059 patients) in the 2nd to 40.05% (1233 patients) in the 3rd period (Table III). The only procedure that was performed less often was laparoscopic hernia repair, with 399 procedures in the 1st period, 320 in the 2nd and 211 in the 3rd one. The number of splenectomies, adrenalectomies and anti-reflux procedures performed increased significantly. Until 1997 no laparoscopic adrenalectomies were performed and splenectomy and Nissen fundoplication were done rather exceptionally. During 1998-2003, 72 splenectomies, 11 adrenalectomies and 32 anti-reflux procedures were completed. In the 3rd period these procedures were much more common and their number increased, respectively, to 195 (splenectomy), 217 (adrenalectomy) and 93 (anti-reflux). Urgent procedures, such as appendectomy or suture of peptic ulcer perforation, rare on the rise of minimally invasive technique, have stabilized at a similar level in the 2nd and 3rd periods (Table III).

Of 8732 procedures begun with laparoscopy, 8478 were completed with this technique. In 254 patients (2.91%) conversion to classic technique was necessary. The conversion rate of 3.97% in the 1st time period dropped significantly ($p < 0.001$) to 1.81% in the 2nd period only to increase again to 3.28% in the 3rd one. Of all 254 conversions, 223 (2.55% of a total of 8478 procedures) were due to technical reasons. Difficulties in anatomical identification, presence of inflammation, tough adhesions preventing safe preparation and identification of the structures,

Table II. Age and sex of patients operated on in each time period

	Sex	n (%)	Mean age [years]
1 st period	Men	762 (32.52%)	45.8
	Women	1581 (67.48%)	47.6
	Total	2343	47.1
2 nd period	Men	1045 (31.57%)	48.9
	Women	2265 (68.43%)	52.8
	Total	3310	50.9
3 rd period	Men	1233 (40.05%)	51.3
	Women	1846 (59.95%)	54.2
	Total	3079	53.1
Total		8732	51.8

fistulas and advanced cancer were the main reasons for conversion. In 31 patients (0.36%) it was caused by intraoperative complications, requiring open repair. The most frequent ones were laparoscopically untreatable haemorrhages (14 patients), biliary tree injury diagnosed intraoperatively and repaired on laparotomy (13 patients), lesion (or suspected lesion) of the GI tract (3 patients) and injury of large vessels in the retroperitoneal space (1 patient). The complication-driven conversion rate was 0.6% in the 1st peri-

Table III. Types of laparoscopic procedures performed in each time period categorised as basic procedures (cholecystectomy) and advanced procedures (other than cholecystectomy)

Type of procedure	1 st period (1992-1997)	2 nd period (1998-2003)	3 rd period (2004-2009)	Total
Cholecystectomy	1809 (72.21%)	2257 (68.19%)	1846 (59.95%)	5912
Other	534 (22.79%)	1053 (31.81%)	1233 (40.05%)	
Appendectomy	71	458	327	856
Suture of perforation	6	46	43	95
Hernia repair	399	320	211	930
Fundoplication	10	32	93	135
Splenectomy	2	72	195	269
Adrenalectomy	0	11	217	228
Other	46	114	147	307
Total	2343	3310	3079	8732

Table IV. Incidence and causes of conversion in each time period

	Number of procedures	Conversions (total)		Conversions for technical reasons		Forced conversions	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1 st period	2343	93	3.97	79	3.37	14	0.60
2 nd period	3310	60	1.81	51	1.54	9	0.27
3 rd period	3079	101	3.28	92	3.02	8	0.26
Total	8732	254	2.91	223	2.55	31	0.36

od (14 patients), dropped to 0.27% in the 2nd period (9 patients) and remained at this level (0.26% – 8 patients) in the 3rd one (Table IV).

In the whole study major intraoperative complications were successfully treated with laparoscopy, without the need for conversion, in 4 patients. Three of them were perforations of the digestive tract (stomach, splenic flexure of the colon and small bowel). In 1 patient, the inferior vena cava injured during adrenalectomy was sutured laparoscopically.

Forty-two postoperative complications (0.48% of patients) requiring re-operation occurred. Most often (*n* = 22) it was a haemorrhage, successfully treated with re-laparoscopy in 17 patients. Fourteen patients needed re-operation for abdominal abscess (7 post splenectomy, 3 after appendectomy and 4 after cholecystectomy). Nine of them were effectively treated with laparoscopy, while the others needed a classical procedure. In 4 patients biliary tree injury was unnoticed during primary laparoscopy. All of them were re-operated on with classical technique.

One patient needed open surgery for injury of the ureter, which occurred during resection of the retro-caecal appendix. One patient had re-laparoscopy on the day of primary surgery due to a foreign body left during abdominal hernia repair. The rate of complication-related re-interventions in the discussed time periods was 0.47% (11 patients) in the 1st, 0.39% (13 patients) in the 2nd, and 0.58% (18 patients) in the 3rd.

Altogether intra- and early postoperative complications requiring surgical treatment occurred in 77 patients (0.88%). In the 1st period their rate was 1.11 (26 patients), in the 2nd it was 0.73% (24 patients) and in the 3rd 0.88% (27 patients). The rate of haemorrhage necessitating conversion or re-operation dropped from 0.6% in the 1st time period to 0.3% in the 2nd and 0.39 in the 3rd. Biliary tree injuries, which occurred in 0.34% of patients in the 1st period, dropped to 0.12% in the 2nd and 0.16% in the 3rd. Incidence of intra-abdominal abscesses of 0.09% during the 1st period rose to 0.15% and 0.23%, respectively (Table V). Of 77 patients requiring surgery for intra- or

Table V. Types of complications of laparoscopic procedures in each study period

		1 st period (1992-1997)		2 nd period (1998-2003)		3 rd period (2004-2009)		Total	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of procedures		2343		3310		3079		8732	
Complications	Haemorrhage	14	0.60	10	0.30	12	0.39	36	0.41
	Damage of common bile duct	8	0.34	4	0.12	5	0.16	17	0.19
	Abscesses	2	0.09	5	0.15	7	0.23	14	0.16
	Other	2	0.09	5	0.15	3	0.10	10	0.11
Total		26	1.11	24	0.73	27	0.88	77	0.88

Table VI. Treatment of complications requiring surgical intervention

	1 st period (1992-1997)		2 nd period (1998-2003)		3 rd period (2004-2009)		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of procedures	2343		3310		3079		8732	
Complications	25		24		28		77	
Open intervention:	20	80.0	13	54.17	13	46.43	46	59.74
• Forced conversions	14		9		8		31	
• Classical re-operations	6		4		5		15	
Laparoscopic intervention:	5	20.0	11	45.83	15	53.57	31	40.26
• Primary laparoscopic	1		2		1		4	
• Laparoscopic re-operations	4		9		14		27	

postoperative complications 31 (40.26%) were successfully treated with laparoscopic technique. In the remaining 46 conversion (59.74%) or re-operation laparotomy was necessary. In consecutive time periods the use of laparoscopy in treatment of complications increased gradually from 20% in the 1st period to 45.83% and 53.57% in the 2nd and 3rd period. Today, the majority of complications of laparoscopic surgery that need re-intervention are dealt with using minimally invasive techniques (Table VI).

Discussion

The natural history of introduction of laparoscopic surgery usually begins with sceptical, and then more and more enthusiastic introduction of the first laparoscopic cholecystectomies. After gaining some experience these procedures are performed more frequently within the centre until nearly all, but suspected of cancer, patients with gallstones are initially qualified for laparoscopy. The time to achieve this point – often called the ‘learning curve’ – is characterized by a high rate of conversions and complications [1-7]. In the next stage, the number of procedures performed laparoscopically increases significantly and the spectrum of indications broadens. Year after year, the rate of technically advanced procedures, such as Nissen fundoplication, cardiomyotomy, splenectomy and adrenalectomy, increases [8-11]. In spite of proven experience, the complexity of new procedures and freer qualification of patients prevent the total number of adverse events from

falling substantially [8, 10]. This trend of gradually increasing difficulty of procedures when introducing laparoscopic surgery was also noted in this study. The percentage of procedures other than cholecystectomy increased significantly, from 22.79% during the first 6 years from introduction of the method to 31.81% and 40.05% today. What is interesting, the rate of laparoscopic hernia repairs decreased over time. Economic factors undoubtedly played a role in this phenomenon, but the technical complexity of this procedure and the need for general anaesthesia limit the indications. In many centres, after initial enthusiasm, these procedures are reserved for patients with bilateral and recurrent hernias.

Incidence of complications of laparoscopy according to the literature ranges from 0.35% to 10% [2, 4, 6, 12]. The rate of complications seen in our material (0.88%) is rather low. This index was higher in the initial period (1.11%) and then remained at a stable level (0.73% and 0.88%) despite increased complexity and broadened indications for laparoscopic surgery.

The conversion rate is usually estimated at 1-5% and depends mostly on the experience of the surgeon and extent of surgery [5, 7, 8, 11, 13-15]. In our material the number of conversions (2.91%) fell into this range. It should be underlined, however, that the majority of conversions (2.55%) were planned, i.e. occurred for technical reasons and not due to complications. After temporary reduction to 1.54% in the 2nd period, the conversion rate increased again to 3.02% due to a much higher number of difficult, complex procedures performed. This phenomenon is

often described in the literature [5, 9, 10, 11, 14, 15]. More importantly, complication-driven conversions were reduced significantly, from 0.6% in the 1st period to 0.27% and 0.26%.

When analysing complications attributable to laparoscopic surgery, we are obliged to discuss the most important and frequent one, i.e. biliary tree lesions. Associated with the most common laparoscopic procedure, it is extensively discussed in the literature [1, 3, 16-19]. Its occurrence ought not to exceed 0.2% in experienced centres. The rates usually fall between 0.13% and 0.59% [1, 3]. Brazilian authors have tried to explain a decrease in incidence of this severe complication at least partially with the experience of the operating teams. According to their publication, in centres performing fewer than 50 laparoscopic cholecystectomies a year the rate of biliary tree injuries was 0.77% and in those performing more than 500 it was only 0.16% [12]. Although the incidence of this complication dropped in our material from 0.34% to 0.12% and 0.16% in consecutive time periods, it should never be ignored as results of its treatment are not very optimistic and these patients need constant vigilance and subsequent interventions [1, 3, 17, 18].

Haemorrhage requiring intervention with open technique (conversion) or re-operation was the most frequent adverse event in the presented material. Its rate decreased from 0.6% to 0.3% and 0.39%; nevertheless, it remains a serious clinical problem. In 14 patients haemorrhage resulted in conversion. In 6 of them the cystic artery or gall bladder groove was the source of bleeding. Most of them occurred early after introduction of laparoscopic technique, when the surgeon had no experience in assessment of the severity of this complication and safe management with minimally invasive methods. In 5 patients, massive haemorrhage from the splenic vessels (usually the vein) occurred. In the remaining 3 patients other lesions were found (injury of the aorta, inferior epigastric vessels and spleen). Of all 22 cases of bleeding that required re-operation, most often (12 patients) the origin was a trocar site. Only in 4 patients was the source of bleeding located within the surgical site (branch of the cystic artery, appendicular or splenic). In 2 patients haemorrhage from subcapsular haematoma of the liver and spleen occurred. In the remaining 6, no active bleeding was found during re-intervention. After flushing the peritoneal cavity and placement of the drainage, no recurrence of haemorrhage was seen. It is worth

stressing that today more and more of these complications can be successfully treated with laparoscopy and we observed a similar tendency in our material. The authors who discuss haemorrhage as a complication of laparoscopy emphasize the importance of meticulous assessment of haemostasis not only in the operative field, but also (or even in the first place) at the trocar sites [2, 5, 14, 19, 20]. Re-laparoscopy plays an important role in assessment and treatment of this complication. Second-look laparoscopy, when performed early, does not pose extra risk for the patient and allows for precise diagnosis and in many instances also for proper management [2, 5, 19, 20].

Infectious complications not associated with the trocar sites have risen to become an important issue. Herein, we present an increasing rate of intra-abdominal abscesses from 0.09% to 0.15% and 0.23%. It may be related to the increasing level of difficulty of the procedures. Patients with acute cholecystitis are qualified for laparoscopic treatment more often and hence the risk of this complication is obviously higher. It could have been responsible for intra-abdominal abscesses in 4 of 14 cases in our material. As other authors have noticed, other emergency procedures, especially appendectomy for acute appendicitis, can add to this phenomenon [2, 20-23, 25]. Abscesses as a complication of laparoscopic appendectomy were seen in 3 patients. The increasing number of procedures in immunosuppressed patients (due to chronic steroid therapy or splenectomy) may also be an issue. Our experience shows that abscesses in this group of patients, although uncommon, can be extremely difficult to treat. Abscess in the post-splenectomy site was found in 7 patients [7, 21, 22].

It is not easy to comment on less frequent complications such as injuries of the GI tract [24, 26, 27] or large retroperitoneal vessels [15, 28]. Although they affect the method significantly, they happen so rarely that it is difficult to find any epidemiological pattern. Similarly to our material, the literature on laparoscopy shows increasing use of this technique in treatment of complications [4, 10, 19, 24, 29]. These of course are not biliary tree injuries, but haemorrhage, abscess and some selected digestive tract injuries can be effectively treated with laparoscopic technique and minimum risk to the patient. In our material, application of minimally invasive techniques increased slowly from 20% in the 1st period to 45.83% in the 2nd and 53.57% nowadays. Such a trend can be seen in reports by other authors, who

believe that the vast majority of complications of laparoscopy can be treated effectively with the very same technique [4, 10, 19, 24, 29].

Conclusions

During the study period, the number of procedures did not change significantly over time, yet the percentage of advanced procedures grew at the cost of cholecystectomy.

The introduction of more and more sophisticated procedures did not significantly affect the complication rate. Change of the character of complications was seen: the rate of haemorrhage and biliary tree injuries dropped, but intra-abdominal abscesses became more frequent.

Laparoscopic technique is used more often in treatment of complications.

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